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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<p>(21) International Application Number: PCT/US00/12107</p> <p>(22) International Filing Date: 4 May 2000 (04.05.00)</p> <p>(30) Priority Data: 09/307,150 7 May 1999 (07.05.99) US</p> <p>(71) Applicant (for all designated States except US): S. C. JOHNSON & SON, INC. [US/US]; 1525 Howe Street, Racine, WI 53403 (US).</p> <p>(72) Inventors; and (75) Inventors/Applicants (for US only): FLASHINSKI, Stanley, J. [US/US]; 5508 River Hills Road, Racine, WI 53402 (US). VNUK, Nancy, J. [US/US]; 1512 Walnut Street, South Milwaukee, WI 53172 (US). BOOTZ, Lori, J. [US/US]; 9006 W. Dakota Street, West Allis, WI 53227 (US).</p> <p>(74) Agents: HOUSER, David, J. et al.; S. C. Johnson & Son, Inc., Patent Section, 1525 Howe Street, Racine, WI 53403 (US).</p>	<p>(81) Designated States: AU, BR, CN, CZ, HU, IN, JP, KR, KZ, MX, NZ, PL, RO, RU, SK, TR, UA, US, VN, ZA, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).</p> <p>Published <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i></p>	
<p>(54) Title: MAT FOR DISPENSING VOLATILE MATERIALS</p> <p>(57) Abstract</p> <p>Disclosed herein are mats for dispensing volatile vapors such as insecticides. The mats are multi-layered. One layer is a carrier layer impregnated with the volatile. It is secured to at least one metal layer. The metal layer spreads the heat from a heater, thereby minimizing hot spots. In other embodiments additional layers are provided to provide a further heat distribution or temperature step down. An air gap can be provided between two of the layers. Also disclosed are such mats that are essentially free of piperonyl butoxide. A method of controlling insects using such mats is also disclosed.</p>		

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MAT FOR DISPENSING VOLATILE MATERIALS

BACKGROUND OF THE INVENTION

5 This invention relates to dispensing volatile materials such as pest control materials, including but not limited to insecticides and insect repellents, and fragrances. More particularly, it relates to volatile material-containing mats that are employed in conjunction with electrical, gas, flammable liquid, or wax-fueled heaters or other sources of heat. One type of electrical heater used for this purpose is sold by S.C. Johnson & Son, Inc. under the
10 trademark FUYI VAPE.

 It is known in the art to impregnate a solid, porous cellulosic mat with a volatile material or to place a volatile material in a pan-like metal structure. These mats and pans are placed on heaters to cause the volatile material to vaporize into the atmosphere.

 A problem with the metal pan-like structures is that for typical heaters they can cause
15 a volatile material to be exposed to too much heat. This can cause the volatile to be used up too fast or be deteriorated or destroyed through thermal degradation.

 The mats have similar problems and also have problems with respect to their being exposed to differing temperatures across a heater surface. Low-cost existing heaters often have hotter regions at certain points along their burner surface. The mats therefore can have
20 uneven and inefficient vaporization.

 The above problems are of increased concern for extended longevity products intended to be used for a week or more. Merely adding additional volatile to increase product capacity and longevity does not work well because prolonged exposure of volatiles to too high temperatures can degrade or destroy the volatile and because, with hot temperatures, a
25 disproportionate amount of the volatile can be driven off initially, with an insufficient amount surviving to be released in useful amounts at a later time.

 Another design consideration is that existing heaters, for safety and other reasons, often only accept slab-like inserts having a small cross-sectional shape, necessary to fit into a small heater loading port or opening. Thus, any solution to the extended longevity problem
30 preferably takes into account size restrictions imposed by existing heaters.

Yet another critical design consideration is cost. Mats of this type are often used in countries that have very modest average annual incomes. To have much practical application in those countries, the mats must be inexpensive.

As such, it can be seen that a need exists for an improved volatile dispensing device.

5

BRIEF SUMMARY OF THE INVENTION

In one aspect, the invention provides a mat for dispensing volatile vapors when the mat is heated. The mat has a carrier layer having a solid carrier material with a volatile material placed therein, the carrier material being constructed and arranged so as to emit the volatile material when heated. The term "solid" carrier material is meant to distinguish liquids, soft gels, and other materials that require containers for their use on a heater. In contrast, "solid" carrier material is defined to include any material having physical properties such that it does not need to be held in a container, including, by way of example only, felted or woven fibrous materials, solid or foamed polymers, ceramics, and the like. The preferred carrier material is a felted, cellulosic material.

There is also a first metal layer secured to a side of the carrier layer. Preferably the first metal layer is secured adhesively, although crimping, riveting, and other ways to attach two layers can be used and would fall within the spirit and scope of the invention. Unless a contrary result is specified, all layers secured to each other, as described herein, can be secured by any of these or equivalent ways of doing so, although adhesive attachment is generally preferred. When a side of the metal layer opposite the carrier material is heated, the metal layer distributes heat along itself and transmits heat to the carrier.

The volatile material is preferably an insecticide, insect repellent, developmental controller, or other insect control material. Alternatively, the volatile material may be a fragrance, deodorizer, or other air quality modifying material. The volatile material can be added to the carrier layer by any convenient method, including but not limited to the conventional methods well known to the art by which active materials are applied to conventional mosquito mats.

In a second embodiment, the mat also has a non-metallic layer secured to a side of the first metal layer opposite the carrier layer. The non-metallic layer provides a temperature step down from the temperature of the heater to that experienced by the volatile material.

Preferably, there is also a second metal layer secured to a side of the non-metallic layer opposite the first metal layer. This embodiment provides further temperature step down and distribution.

In still another embodiment, the last layer most distant from the volatile material is a non-metallic layer, which then contacts the heater. This embodiment is particularly desirable for heaters that have poor temperature control.

In yet another embodiment, the mat has a non-metallic layer with leg portions extending therefrom, preferably extending downwardly, away from the volatile material, and the mat also has a second metal layer adhesively secured to the legs opposite the first metal layer. By this arrangement, a cavity is provided between a portion of the non-metallic layer and the second metal layer. This embodiment is particularly desirable with respect to heaters that occasionally provide temperature spikes.

The mats of the present invention spread heat more uniformly across their surface, as well as reduce excess temperatures that may be developed from poorly controlled heaters or heaters designed for use with less temperature sensitive volatiles.

These and still other features and advantages of the present invention will be apparent from the description which follows. The following description is of the preferred embodiments. The claims should be looked to in order to understand the full scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a vertical sectional view showing a mat for dispensing volatile materials of the present invention;

Figs. 2, 3, and 4 are views similar to Fig. 1, albeit showing three additional embodiments; and

Fig. 5 is both a left side and frontal view of the Fig. 4 embodiment.

DETAILED DESCRIPTION

Fig. 1 shows in dotted lines a portion 10 of an electrical heater. The heater can be the FUYI VAPE heater previously described, except that the single layer mat conventionally used with that heater has now been replaced with a mat of the present invention. The FUYI

VAPE heater is an electrical-resistance heater having a flat, upwardly exposed plate 10 on/against which is placed a mat generally 12 (or 12A or 12B or 12C) of the present invention. Although the FUYI VAPE heater is shown by way of example, other heaters of any type intended for use with comparable mats could be used instead.

5 For purposes of convenient description, the hot heater surface will be designated as being in a "down" direction, with features of mats being referred to as being "upper" or "lower" or "above" or "below" each other. In fact, the hot heater surface of some conventional heaters are vertical, but such variation is not important to an understanding of the mat of the invention.

10 Mat 12 has an upper, solid carrier layer 14, preferably made of paper or other porous, cellulose-based material. Other solid porous substrates could also be used, such as sintered glass, plastic beads, ceramic materials, natural or synthetic fabrics, and other absorbent and adsorbent materials. Alternatively, the solid carrier layer 14 can be of a non-porous material so long as it is capable of holding the volatile to be released. Carrier layer 14 is impregnated
15 with or otherwise bears a volatile 16. When placed over the heater the volatile is released from it when mat 12 is heated.

Under the carrier layer 14 is a first layer 18 of metallic material such as aluminum. It is secured to the carrier layer 14, preferably by an adhesive 20. The preferred adhesive is a polymeric adhesive sold as adhesive "711" available from Manufacturer Resources Inc. of
20 New Berlin, Wis. Other adhesives could also be used, such as high temperature resistant acrylics and urethanes. When selecting adhesives it is desirable that the adhesive be heat-stable and be able to bond a metal layer to a non-metallic layer. Further, it is preferred that the insulating characteristics of the adhesive be minimal.

The first metal layer 18 distributes heat across itself and then to carrier layer 14. This
25 helps reduce hot spots and to some extent provides a temperature step down.

Figs. 2-5 illustrate alternative embodiments, wherein similar components are indicated with similar reference numbers, except with an A, B, or C suffix.

Referring to Fig. 2, mat 12A includes a carrier layer 14A impregnated with volatile material 16A as well as first and second metal layers 18A and 26A. It also includes a layer
30 22A of low heat-conductive material such as fiber mat, ceramic, cellulose, etc. If desired and correctly chosen, the same material used for carrier layer 14A also can be used for layer 22A,

albeit without the volatile. Preferably, adhesives 20A, 24A and 28A, which can all be the "711" adhesive or similar adhesives, secure the layers together. Embodiment 12A offers additional uniform heat distribution as well as an even more pronounced temperature step down.

5 Embodiment 12B (shown in Fig. 3) is similar to embodiment 12A, except that it does not have the metallic layer 26A or intervening adhesive 28A. Non-metallic material 22B is placed in direct contact with the heater.

 Embodiment 12C (shown in Figs. 4 and 5) is somewhat similar to embodiment 12B, except that the low heat-conductive, non-metallic layer 22C has a cavity portion 30C
10 provided by legs 32C and 34C. This cavity provides an air gap permitting even further reduction of hot spots near the center of the mat. Second metal layer 36C extends from one leg 32C to the other 34C, the metal layer being secured to the legs 32C and 34C by adhesive 38C and 40C. The cavity can be open to the air at the sides, or, as shown in the drawings, can be completely enclosed at the sides.

15 The volatile material is preferably one of (or mixtures of) known insecticides and insect repellents. Particularly preferred are organic phosphorous insecticides, lipidamide insecticides, natural repellents as citronella oil, natural pyrethrins and pyrethrum extract, and synthetic pyrethroids. Suitable synthetic pyrethroids are allethrin as Pynamin, d-allethrin as Pynamin forte®, benfluthrin, bifenthrin, bioallethrin, S-bioallethrin, esbiothrin, esbiol,
20 bioresmethrin, cycloprothrin, cyfluthrin, beta-cyfluthrin, cyhalothrin, lambda-cyhalothrin, cypermethrin, alpha-cypermethrin, beta-cypermethrin, cyphenothrin, deltamethrin, empenthrin, esfenvalerate, fenpropathrin, fenvalerate, flucythrinate, tau-fluvalinate, kadethrin, permethrin, phenothrin, prallethrin as Etoc®, resmethrin, tefluthrin, tetramethrin, transfluthrin, or tralomethrin. Other volatile insecticides as described in U.S. patent 4,439,415 can also be
25 employed. The disclosure of that patent is incorporated herein in full, by reference, as are the disclosures of all patents or publications referred to herein.

 Most preferred is Pynamin Forte®. Particularly desirable performance has been achieved by dissolving 40 mg of this active ingredient in 60 mg of the hydrocarbon solvent Isopar M (from Exxon). 100 mg of the resulting solution is used to impregnate the cellulose
30 portion of a substantially flat mat having 22 mm x 35 mm top view dimension. Preferably

the cellulose layer is approximately 2.5 mm thick and is adhered to a .5 mm thick aluminum foil using 10 mg of the 711 adhesive prior to impregnation.

Conventionally, piperonyl butoxide is co-delivered with insecticides or other insect control materials as a synergist that improves the insect control effect of the insecticides or other insect control materials. Surprisingly, it has been found that mats made in accordance with the invention having a volatile material that includes an insecticide or other insect control material but that is essentially free of piperonyl butoxide perform as well as conventional, fibrous mats that include both the insecticide or other insect control material and piperonyl butoxide. A mat of the invention is defined as being "essentially free of piperonyl butoxide" if it contains piperonyl butoxide at a level less than that level at which an increase in insect control effect can be detected against *Aedes aegypti* mosquitoes when piperonyl butoxide is added to a conventional, fibrous mat bearing the same amount of insecticide or other insect control material as the mat of the invention. In any event, while piperonyl butoxide amounts of about a 1:1 ratio with insecticide by weight are conventional in the art, a preferred mat of the invention is one whose volatile material has less than a ratio of 1:4 by weight of piperonyl butoxide to the weight of insecticide or other insect control material. Most preferably, no piperonyl butoxide is present at all.

Deodorizers may also be used with the mat of the invention, such as a terpene based deodorizer fragrance. Further, volatile fragrances, disinfectants, or other air quality modifying agents may be used, such as glycols, trimethylene, and dipropylene. In addition, organic acids that are compatible with the use of the substrate and the atmosphere can also be utilized.

The method of the invention for controlling insects includes a first steps of providing a mat having a solid carrier layer having placed therein a volatile material including an insect control material, the carrier layer being constructed and arranged so as to emit the volatile material when heated; the mat also having a first metal layer secured to a side of the carrier layer. The second step of the method is to apply heat to the first metal layer in an amount sufficient to volatilize the insect control material.

The heat and amount of volatile material must be sufficient to volatilize insect control material in amounts sufficient to achieve the desired amount of insect control. The specific amount of volatile material and heat will depend on the insect control material used and

volume of space within which insects are to be controlled. Determining such parameters is well within the skill of the person skilled in this art. Preferably, the step of providing a mat includes providing a mat wherein the volatile material is essentially free of piperonyl butoxide, as the term "essentially free of piperonyl butoxide" has been defined, above.

- 5 Alternatively, that step includes providing a mat wherein the volatile material includes no more than a ratio of 1:4 by weight of piperonyl butoxide to the insecticide or other insect control material. Preferably, that step includes providing a mat entirely free of piperonyl butoxide.

- 10 The invention is not to be limited to the specific embodiments shown. Rather, the claims should be looked to in order to appreciate the full scope of the claimed invention.

INDUSTRIAL APPLICABILITY

- The invention provides mats for dispensing volatile materials such as insecticides. The mats are particularly useful in controlling mosquitoes over extended periods. The
15 invention also includes practical methods for controlling mosquitoes.

CLAIMS

1. A mat for dispensing volatile vapors when heated, the mat comprising:
 - a. a solid carrier layer having a volatile material placed therein, the carrier layer
5 being constructed and arranged so as to emit the volatile material when heated;
and
 - b. a first metal layer secured to a side of the carrier layer, whereby, upon heating of a
side of the metal layer opposite the carrier layer, the metal layer will distribute
heat along itself and transmit heat to the carrier layer.
- 10 2. The mat of claim 1, wherein the volatile material is selected from the group consisting of
insecticides, insect repellents, insect developmental controllers, and combinations thereof.
3. The mat of claim 1, wherein the carrier layer is a cellulosic material.
- 15 4. The mat of claim 1, further comprising:
 - a. a non-metallic layer secured to a side of the first metal layer opposite the carrier
layer; and
 - b. a second metal layer secured to a side of the non-metallic layer opposite the first
20 metal layer.
5. The mat of claim 1, further comprising a non-metallic layer secured to a side of the first
metal layer opposite the carrier layer.
- 25 6. The mat of claim 5, wherein the carrier layer has a thickness which is essentially the same
as the first metal layer.
7. The mat of claim 5, wherein the non-metallic layer has leg portions extending therefrom
and the mat further comprises a second metal layer adhesively secured to the legs opposite the
30 first metal layer.

8. The mat of claim 7, wherein a cavity is provided between a portion of the non-metallic layer and the second metal layer.

9. The mat of claim 1, wherein the volatile material includes an insect control material and also includes no more than a 1:4 ratio by weight of piperonyl butoxide to insect control material.

10. The mat of claim 1, wherein the volatile material includes an insect control material and is essentially free of piperonyl butoxide.

11. The mat of claim 10 wherein the volatile material includes no piperonyl butoxide.

12. A method of controlling insects comprising the steps of:

- a. providing a mat having a solid carrier layer having placed therein a volatile material including an insect control material, the carrier layer being constructed and arranged so as to emit the volatile material when heated; the mat also having a first metal layer secured to a side of the carrier layer;
- b. applying heat to the first metal layer in an amount sufficient to volatilize the insect control material.

13. The method of claim 12 wherein the step of providing a mat includes providing a mat wherein the volatile material is essentially free of piperonyl butoxide.

14. The method of claim 12 wherein the step of providing a mat includes providing a mat wherein the volatile material includes no more than a 1:4 ratio by weight of piperonyl butoxide to insect control material.

15. The method of claim 12 wherein the step of providing a mat includes providing a mat entirely free of piperonyl butoxide.

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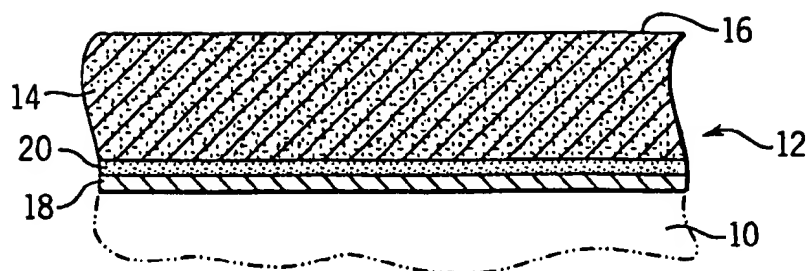


FIG. 1

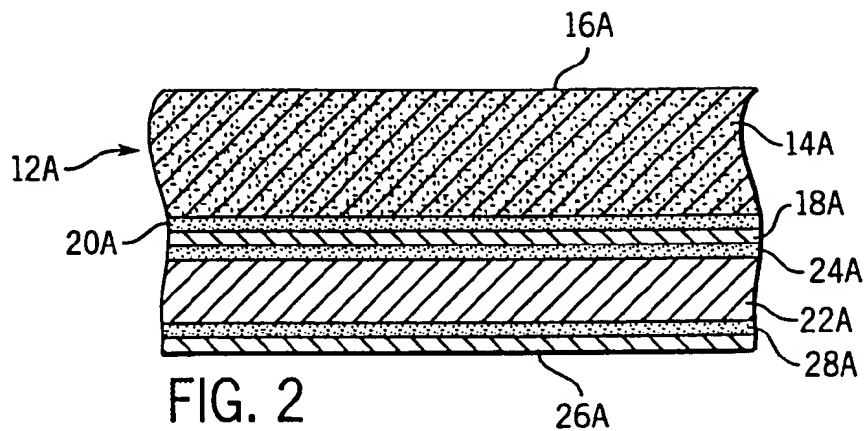


FIG. 2

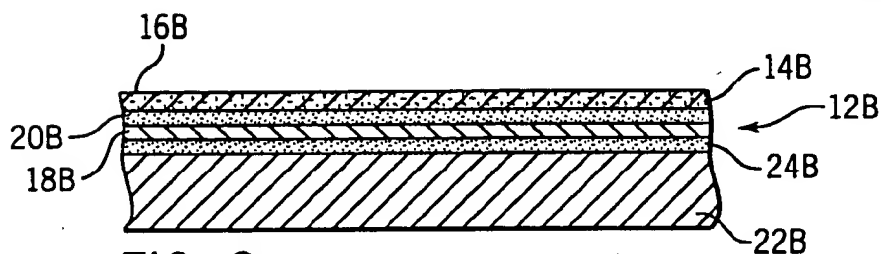


FIG. 3

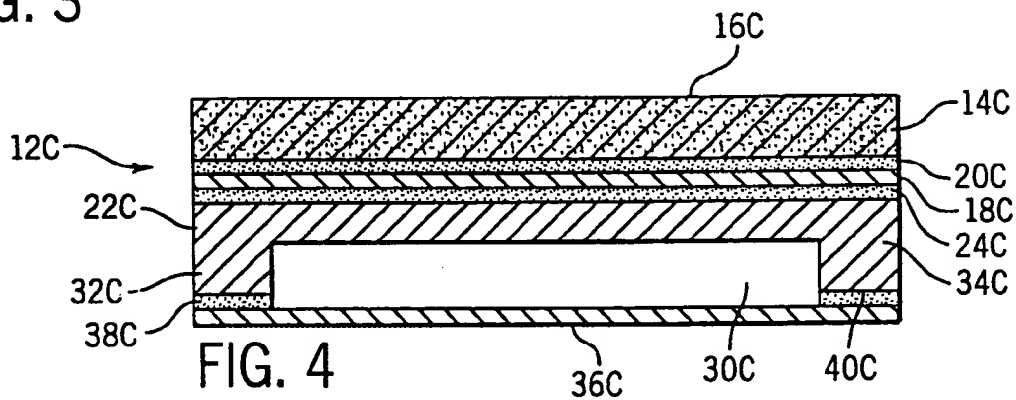


FIG. 4

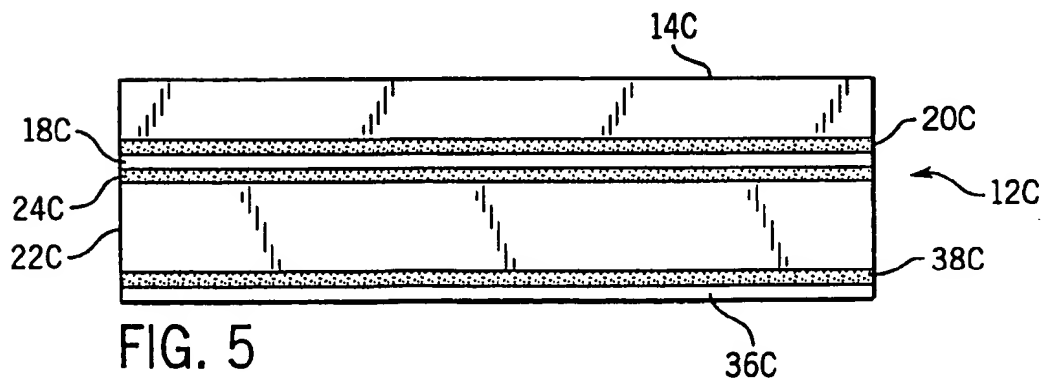


FIG. 5

INTERNATIONAL SEARCH REPORT

Int l Application No

PCT/US 00/12107

A. CLASSIFICATION OF SUBJECT MATTER
 IPC 7 A01N25/34 A01N25/18

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 A01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

WPI Data, PAJ, EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2 166 653 A (BRATITCH EDWARD) 14 May 1986 (1986-05-14) page 1 -page 2, line 75	1-3,9-11
A	page 2, line 76 -page 3, line 27	4-8, 12-15
X	PATENT ABSTRACTS OF JAPAN vol. 012, no. 372 (C-533), 5 October 1988 (1988-10-05) & JP 63 122603 A (OIKE IND CO LTD), 26 May 1988 (1988-05-26) abstract	1-6,9-11

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

20 September 2000

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INTERNATIONAL SEARCH REPORT

Int'l Application No

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p>DATABASE WPI Section Ch, Week 198238 Derwent Publications Ltd., London, GB; Class A32, AN 1982-80239E XP002147906 & JP 57 131550 A (NITTO ELECTRIC IND CO), 14 August 1982 (1982-08-14) abstract</p> <p>-----</p>	1,2,9-11

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

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